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be permitted to make a copy of the plate. Doubtless I might have forgotten the whole circumstance of my friend's very special interest in the fine colored plate under which Le Conte, now ninety years since, had written in pencil " *V. affinis*," but for his surprising request. I now see that Mr. Pollard's purpose was fully formed then, to suppress *V. affinis* in favor of *V. obliqua;* and I repeat, that I never knew he had done so, until now Mr. Bicknell has adverted to the fact in print.

It was never my own thought to displace the name *V. affinis* or any other, and write *V. obliqua* instead. I do not yet know any violet that has the subfalcately cuspidate leaves and perfectly serrate foliage—it is even sharply as well as exactly serrate—of Hill's figure. An artist's error which amounts to an absolute falsification in respect characters held essential should never, in my judgment, be permitted to stand as a specific type; and I strongly suspect that such an opinion as this, conceived by others, had been the reason, and as I think a perfectly valid one, for ignoring the *V. obliqua* as applied by Mr. Pollard in Britton's Manual.

Washington, D. C.

A New Midland Violet and Some Notes on "Cleistogamous" Flowers.

(*Two Plates.*)

BY J. A. NIEUWLAND.

Viola candidula Nwd. Sp. Nov.

Planta verna circa 13 cm. alta perglabra, foliis florum altitudinem haud aequantibus. Sepala inferiora circa 7 mm. longa vix acuta, etiam obtusa, vel plus minusve rotundata, glaberrima, obscure 3-nervia, margine anguste scarioso vel membranoso. Corolla alba latior quam longior, petalis superioribus latissime obtusis suborbicularibus, 12 mm. longis 10 mm. latis, vel latioribus, lateralibus breviter sed crebre barbatis pilis longioribus (usque 1.7 mm.) fere cylindricis acutiusculis vel obtusiusculis, brevioribus obtusis vel rotundatis, et omnibus eleganter clavellatis praecipue brevioribus (pilis parte inferiore circa 24 μ et ad apicem 57–99 μ

diametro.) (Vide figuram.) Petalum inferius aspectu reliquis subaequilongum, concavum, obtusissimum vel minute retusum, nudum, lineis violaceis supra medium vel apicem versus ramosis eleganter notulatis. (Lineae in petalis lateralibus paucae minus ramosae et in superioribus tantum binae vel ternae simplices.) Bracteolæ at medium pedunculi breves lineares subulatæ appositæ. Calcar breve rotundatum purpureis vel violaceis puncticulis exterius coloratum.

Flores apetali aestivi, subterranei sed se ad superficiem fructu facto erigentes, sepalis 5 verisimiliter subaequalibus acutis, ad apicem involutis, et pistillum cum duobus staminibus appresse includentibus, stylo longo brevi hamato vel incurvato staminibus binis appendiculatis alatis compresso: stigmate binis vel quaternis staminum antheris appresso. Aliquando tertium adest parvum et omnino sterile stamen inter altera insitum, vel cum duobus vel tribus minutis tuberculis ad pistilli basim. Folia prima reniformia, viridescentia, crassula, rotunda, cordata, apice obtuso vel rotundato, margine crenato vel obtuse serrato. Folia aestiva majora ad apicem plus elongata circa 6.8 cm. lata et usque 7.5 cm. longa, perglabra, vel cum perpaucis minutis pilis in venis ad apicem superficiei.

In locis humidis sed arenosis inter gramina et carices ad stagnorum ripas crescere invenitur.

Spring plant about 13 cm. high perfectly glabrous growing in clumps: leaves never becoming as long as the flowering peduncles until the summer phase, usually about one half as long. Lower sepals about 7 mm. long obtuse or rounded, glabrous, obscurely 3-nerved, the margins narrowly scarious or membranous. Corolla pure white (!) broader than long: the upper petals broadly obtuse or rounded, suborbicular, 12 mm. long, 10 mm. wide or wider, the lateral ovate or obovate, obscurely retuse, bearded with short and long clavate hairs: (the larger hairs 1.7 mm. long about 24 μ wide below, and 57–99 μ near their apex; the shorter ones more obtuse or rounded) (Fig. 4.) Lower petal apparently in flower equal in length to the others, concave or somewhat carinate obtuse or slightly retuse, naked, elegantly striped with cross-branched violet lines to above the middle, the striations on the lateral and upper petals are much fewer, only about 3 in the latter. Bracts short subulate linear on the middle of the peduncle.

Sac or spur short, rounded, marked on the outside with minute purple dots.

Apetalous summer flowers subterranean but in their wet native habitat rise to the surface where an abundance of seeds is formed in the capsules. The petaliferous flowers also produce abundant seed. Sepals 5 equal or subequal acute at apex and slightly involute in aestivation (Fig. 2a.) completely closed and appressed to the pistil. Style short permanently hooked or recurved between the anthers and appendages of the two equal stamens. Anther sacs obovoid 2 to 4 in the latter case the two inner smaller, opening by a subapical cleft. At times a third perfectly sterile stamen about one half as large as normal is found between the two usual ones and several tubercles at the base of the ovary mark the other abortive stemens. No trace of petals.

First leaves dark green, thickish, reniform, later rounded cordate, apex rounded or obtuse, or minutely retuse, margin crenulate as the lobes below and crenulate serrate above, about 2.2 cm. wide 2.5 cm. long.

Summer leaves with a more elongated apex often about 6.8 cm. wide and 7.5 cm. long, glabrous or when grown in dry soil with very few minute short hairs at the apex on the upper face or the veins. Habitat wet sandy places near the grassy and sedgy shore of lakes.

This beautiful little plant was first found by me east of Benton Harbor, Mich. in spring of 1909 along the shore of the river flood-pond. Owing to the markedly white flowers and appearance of the broad corolla, several plants were taken and planted in a bed near the University Dept. of Botany, together with a number of other violets. The plants became notable by their remarkable tendency to spread. In the second season numerous seedlings over the whole large bed came to maturity and in spite of digging and cultivation a considerable number have this spring been segregated more carefully to a plot by themselves. This spring another visit to Benton Harbor showed that the plant was spreading there also, though considerably checked by encroachment of cultivated land. Several clumps were taken home for study of fresh material, and transferred to a special plot in order to follow up the subsequent development of latter summer phases, and to study the apetalous flowers more carefully. Though the flowers are perfectly white they are so very large that one could not consider the plant of the *V. blanda* group. Moreover, though we at first suspected it to be an albino form of some other blue plant, this idea had to be discarded. The other characters of flower and vegetation disproved this completely. Albino forms of *Viola peramoena* were found growing not very far away along the same pond, but even at that early stage showed no resemblance whatever in floral structure. Their subsequent development in our garden emphasized this difference even more in the vegetation summer phases. Other real albinos and intermediate paler forms found by me in woods near the Four Mile Bridge along the St. Joseph River, north of South Bend, also exhibited in summer phases pubescent large leaved plants not at all like *V. candidula.* As far as I have been able to determine the plant is always white flowered. A clump turned over in the meadow by the plowman showed a tendency in the flower to become faintly purplish (not blue or violet) on the vack of the petals, whereas even then, the inside of the corollas were white. The descriptions were made from live plants in their native habit. The drawings of petaliferous stages were made from such a plant a few days after being taken from the field. The study of apetalous stages and flowers was made from the same plants grown both in garden, and a potted plant in moister situation. The results in each case were the same though in the latter case fewer apetalous flowers produced seed and more petaliferous ones, and vice versa in the former instances. The plant in its native habitat seems to produce its apetalous summer flowers above ground: whereas in drier situations these are subterranean only, comming above ground after the ovules begin to develop. I may select as a type of this new plant No. 11111 of my herbarium collected at Benton Harbor, May 1913, from which the drawings of the accompanying plate were made before pressing. I have not as yet found the plant elsewhere.

There seem to be two widely different opinions as to the development of the so called "cleistogamous" or apetalous summer flowers of certain groups of caulescent and acaulescent violets. This phenomenon occurs also in the *Antennarias* apparently, in *Polygala polygama* and a considerable number of other plants. Having studied the matter only in the aformentioned new violet, as also in *Viola rostrata* and a midland member of the *Viola pedatifida* group from Southern Illinois, grown in my violet garden, I do not wish even to hint at any general conclusions regarding the phenomenon as supposed to occur in violets generally.

It has been asserted on the one hand that the so called cleistogamous or apetalous flowers of violets though they may have rudimentary stamens, are entirely devoid of pollen and that therefore no fertilization whatever takes place, that is, in other words the ovules in these aestival flowers develop parthenogenetically. Others have affirmed that fertilization occurs, therefore presuming that pollen or its equivalent is formed and that close fertilization takes place without the opening of the flowers at all.

Whatever examination has been made of other apetalous flowers we need not discuss here. In examining these flowers of the new plant for diagnosis we found that two anther bearing stamens are always present. The anther sacs are two to four in number, in the latter case the two nearest the pistil larger. None of them are, however, never more than one-fifth as large as the anthers of the petaliferous flowers. The pollen grains though comparatively scanty are more than sufficient to account for the fertilization of the numerous ovules. Pollen need not be as copious as in the petal-bearing spring flowers for the proximity of the two stamens pressed against the stigma obviates waste of pollen which in the closed flower can not be readily lost.

I have found a considerable number of such flowers just in the stages in which the enlarging pistil apparently by friction of of growth upwards together with the compression of the sepals on the outside, causes the rupture of these apparently abortive but only more minute anther sacs of the two closely oppressed stamens. The pollen was found in these instances in various stages of germination of pollen tubes, nearly all of which led to the opening in the stigma of the curved or hooked style (See Fig. 3) the progress of the pollen tubes farther in was not made. A more exact histological study would be necessary. Even after tracing the tubes into the ovary, cytological study of the behavior of the chromosomes in the oospores alone would serve as final evidence when fertilization had actually taken place or not. It would seem that the problem would be an interesting and not perhaps a difficult one for general and more exact study.

Developing pollen tubes were found in apetalous flowers which were as a rule not over 4 mm. long and not less than 2.5 mm. In larger flowers the stamens have dried up completely and as soon as the pollen has escaped the apical membranous appendage of each stamen becomes red. Simultaneously the petiole begins to elongate in the curved portions thus having the two bractlets on the recurved peduncles farther away than the apex of the sepals. A certain variation of these characters is found in subterranean and aerial apetalous flowers. In the plant under consideration as well as of a number of other acaulescent forms where the apetalous flowers are born under or near the ground the peduncles are recurved below the flower, and the short style is always found curved towards the peduncle. The two stamens also are on the side of the pistil facing the recurved stalk of the flower (See Fig. 1a). Of all the specimens which I have examined in sufficiently early stages of growth, I have found either well developed pollen grains in the undehisced anthers or when already dehisced, the pollen tubes growing from the grains into the stigma and style. I have not found a single apetalous flower entirely devoid of well developed stamens. The pollen grains are readily seen with the low power of an ordinary compound microscope, one-inch ocular and two-thirds inch objective. (Fig. 3.)

Before dehiscence particularly the pollen grains vary greatly in size. The walls are not as thick as in those of the petaliferous flowers, which average about 37.5 μ, the variation being only two or three microns. Those of the apetalous flowers range from 23.7 μ to 52 μ in diameter, and have not the peculiar three plate lids on the surface through which the pollen tubes find their exit, characteristic of the pollen of the petal bearing flowers.

Pollen in stages producing pollen tubes were also found in the few apetalous aerial flowers of *Viola rostata* examined. In this the peduncle is not recurved below the flower; the style with more or less abruptly recurved stigma is longer and the spatulate stamens are five in number instead of the two of the acaulescent forms. Should further examination of caulescent and acaulescent violets substantiate this variation in number as constant, a new and important character of distinction of the groups is presented helping to emphasize the fact that they may well be considered, as Spach does, to be different natural genera.

PLATE 2.—*Viola candidula* Nwd. (Natural size.) Parts of spring flower separated. Drawn in late spring phase as the apetalous flowers were beginning to appear, one larger summer leaf also shown. Lower right hand corner: ovary. Same with stamens in place, upper petal, lateral petal, lower petal.

PLATE 3.—Parts of apetalous summer flowers, and (fig. 4) hairs of lateral petals of spring flowers of *Viola candidula*.

FIG. 1a.—Pistil of apetalous flower with stamens appressed to the stigma. (Side view.) A minute sterile stamen on the left between the two fertile ones.

FIG. 1b.—A fertile stamen with four anther sacs. Pollen escaping from the subapical cleft in the two larger sacs. Rudiment of another sterile stamen at the base. [Magnified about 30 diameters].

FIG. 2a.—Cross section showing arrangement of the parts of the apetalous summer flowers. A, position of the recurved petiole. B, sepals, subequal. C, 2 stamens bearing fertile anthers and inserted always next to the petiole A. (The third sterile stamen is ordinarily absent.) D, ovary with ovules.

FIG. 2b.—Front view of pistil with two stamens. (Same as Fig. 1a of another flower without the third sterile stamen.)

FIG. 3.—Side view of recurved style and stigma showing pollen grains sending pollen tubes into the hollow style.

FIG. 4.—Hairs of the beard of the lateral petals greatly magnified. The hairs are spirally striate under high magnification and round, not flattened except in age.

Dept. of Botany,
University of Notre Dame.

Some Littoral Algae of Puget Sound.

CHAS. O. CHAMBERS.

The following study was made at the Puget Sound Marine Station, during the summer of 1909, mainly in the months of July and August. A general survey of the ground had been made the previous summer. Its purpose was to determine what types of algae inhabit the tide-pools; why they prefer these places and how they are specially adapted to such places. The study was made with special reference to *Prionitis*, which seems to be the one prevailing type in all these tide-pools, and showing considerable variation with variety of environment.

The work was suggested and outlined by Professor T. C. Frye, acting director of the Station. No such study had yet been made in this region, though a study somewhat similar in its general character was made by Skinner (8) at Port Renfrew, B. C. The conditions there are quite different, and his study does not attempt to relate types to environment, nor is it specially directed to any

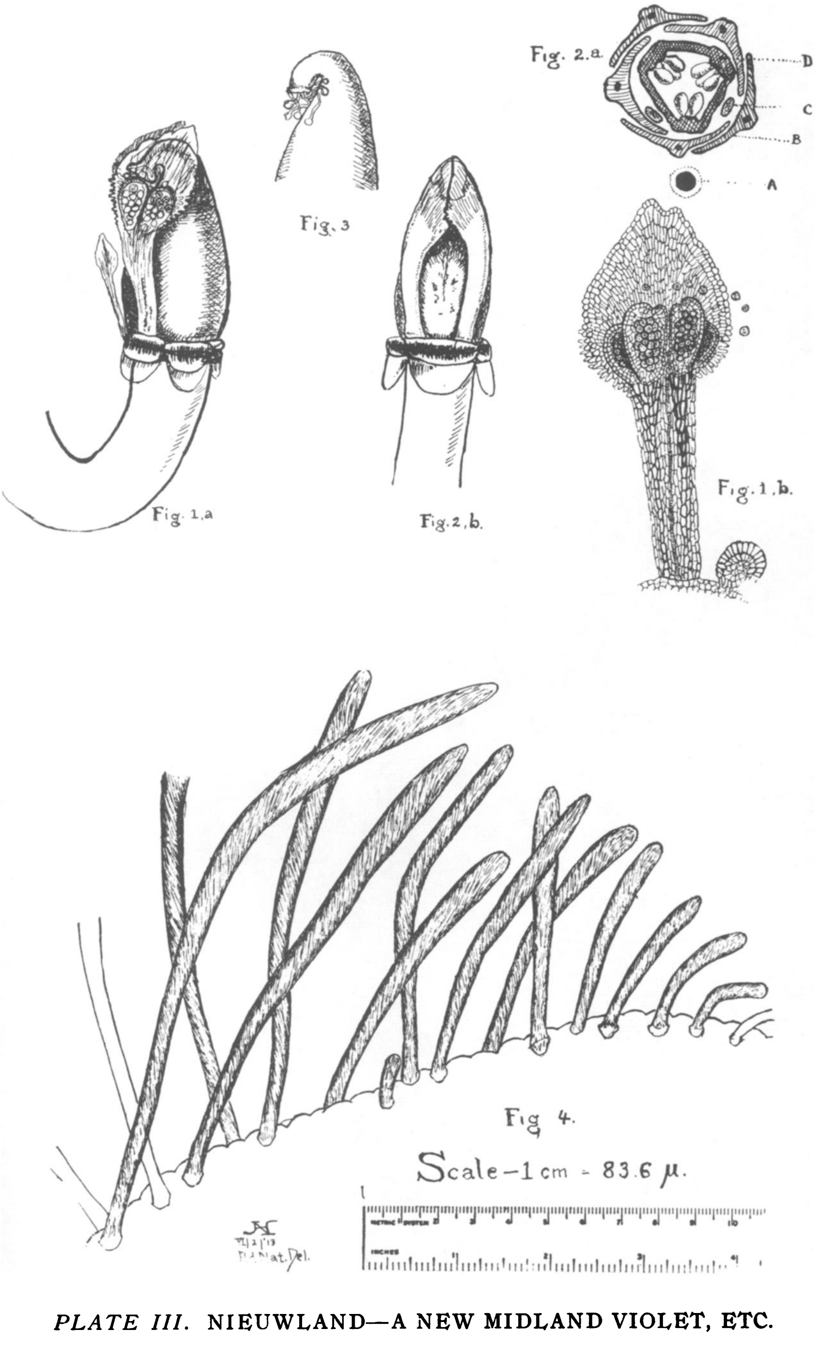

PLATE III. NIEUWLAND—A NEW MIDLAND VIOLET, ETC.